

Homework Assignment 9 is due Friday April 16

Exercise 1: (Boolean OR has a linear separator.) Take as examples all the 2^d elements of $\{0,1\}^d$. Label the example by +1 if there is at least one coordinate with a +1 and label it by -1 if all its coordinates are 0. This is like taking the Boolean OR, except we look upon the coordinates as real numbers. Show that there is a linear separator for these labeled examples. Show that we can achieve a margin of $\Omega(1/d)$ for this problem.

Exercise 2: Show that the parity function, the Boolean function that is 1 if and only if an odd number of inputs is 1, cannot be represented as a threshold function.

Exercise 3: Suppose we have n points in the plane and C is a circle containing at least three points. Prove or disprove the following statement: there is a circle C' so that (i) there are 3 points lying on C' or two points lying on a diameter of C' and (ii) the set of points in C is the same as the set of points in C' .

Exercise 4: Given n points in the plane define two circles as equivalent if they enclose the same set of points. Prove that there are only $O(n^3)$ equivalence classes of points defined by circles and thus only n^3 subsets out of the 2^n subsets can be enclosed by circles.

Exercise 5: Prove that the VC dimension of convex polygons is infinite.

Exercise 6: If a class contains only convex sets prove that no set in which some point is in the convex hull of other points can be shattered.

Exercise 7: Show that there is a set of 3 points which can be shattered by axis-parallel squares. Show that the system of axis-parallel squares cannot shatter any set of 4 points.